Building responsible research and innovation ecosystems

BUILDING RESPONSIBLE RESEARCH AND INNOVATION ECOSYSTEMS THROUGH SHARED AGENDAS. THE CASE OF THE B30 TERRITORY

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CONTENTS

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1. INTRODUCTION

Europe has to address the challenges of the green transition and the digital transition to become a modern, competitive economy that uses natural resources efficiently. For this reason, the European Commission has determined that research and innovation policies should be geared towards sustainability in the broad sense (social, environmental and economic sustainability) via a transformative approach based on the principles of co-creation, dissemination, shared values, circularity and responsible research and innovation (henceforth, RRI).[2]

Within this framework, the European SeeRRI project seeks to promote the integration of RRI into Research and Innovation Strategies for Smart Specialisation (henceforth, RIS3) to build RRI ecosystems.

RRI ecosystems are research and innovation ecosystems that are committed to society and to the transition towards more sustainable and inclusive development. The core feature of RRI ecosystems is active involvement by the regional actors (universities and research and innovation centres, companies, public administrations and civil society) in co-designing and implementing innovative and transformative solutions which more effectively address the regional challenges and contribute to the transition to more sustainable, inclusive and fair development.

As part of the SeeRRI[3] project, Government of Catalonia and the Universitat Autònoma de Barcelona (henceforth, UAB) have worked with regional stakeholders to co-design a pilot project which has been carried out in the B30 territory. The region known as the B30 includes 32 towns located between Martorell and La Roca del Vallès running east to west, and between Castellar del Vallès and Sant Cugat del Vallès running north to south.

2 European Commission (2020): Science Research and Innovation Performance of the EU 2020. A fair green and digital Europe.
3 SeeRRI (2019-2021) is a joint project of 12 organisations from five different countries. It is financed by the Science with and for Society programme in Horizon 2020.

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The pilot project implemented in 2019 and 2020 has attempted to answer two questions:

- How can RIS3 promote RRI as a way to better address the Sustainable Development Goals (henceforth, SDGs) and promote pathways for a more sustainable, inclusive and fair development?
- How can the UAB contribute to a research and innovation ecosystem more responsible and sustainable, which addresses the SDGs and promotes pathways for a more sustainable, inclusive and fair development?

Section 2 introduces the methodological approach of the SeeRRI project and of shared agendas for sustainability and social change of the Catalonia's Smart Specialisation Strategy. (RIS3CAT).

Section 2 describes how these two questions were addressed via the SeeRRI B30 pilot project in 2019 and 2020. This pilot project has focused on one of the main systemic challenges in this region, namely making a highly competitive, inclusive region with a high quality of life compatible with a decarbonised, waste-free economic development model which creates wealth through the resources that it has, generates and receives. Finally, section 4 contains the main lessons learned and the future approach beyond the SeeRRI project.

The document concludes with an Annexe that presents the systemic analysis conducted on the topic of zero-waste in the B30 as part of SeeRRI , which served as the point of departure of the zero-waste shared agenda.

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2. THE RIS3 AND RRI ECOSYSTEMS

2.1. The SeeRRI approach

The SeeRRI project seeks to incorporate RRI into RIS3 to promote more sustainable and inclusive development and make headway towards the SDGs.

In accordance with the framework proposed by Fitjar et al.,[4] SeeRRI focuses on integrating the four dimensions of RRI proposed in Stilgoe et al.[5] into the RIS3:

- Anticipation, via the incorporation of forward-looking exercises: RIS3 are transformative R&D agendas geared at building a more sustainable, inclusive future, and therefore they have to anticipate the impacts of economic, social and environmental actions.
- Reflexibility: RIS3 are not linear agendas but have to entail constant learning and reflection on the potential economic, social and environmental impacts of actions. SeeRRI proposes doing so by formulating alternative future scenarios and analysing crucial factors for the different pathways.
- Inclusion: RIS3 promote participative governance systems in which citizens are engaged alongside public administrations, universities and companies.
- Responsiveness: The processes promoted by RIS3 should be legitimate and reflect society's interests and needs, and therefore they should be promoted by political institutions and civil-society organisations that represent citizens.

4 Fitjar RD, Benneworth P, Asheim BT. (2019) Towards regional responsible research and innovation? Integrating RRI and RIS3 in European innovation policy. Science and Public Policy, 46 (5), 772–783, https://doi.org/10.1093/scipol/scz029
5 Stilgoe, J., Owen, R., Macnaghten, P. (2013). Developing a framework for responsible innovation. Research Policy, 42(9), 1568-1580. https://doi.org/10.1016/j.respol.2013.05.008

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IMAGE 1. INTEGRATION OF THE FOUR DIMENSIONS OF RRI INTO THE RIS3 IN SEERRI

SeeRRI envisions integrating RRI into RIS3 by focusing these strategies on important challenges facing the region and the people living in it, thus overcoming the purely sectoral or technological focus. The challenges should be prioritised by mapping the regional ecosystem bearing in mind global trends and regional initiatives, actors and resources, as well as the current situation and different possible futures. For each of the challenges prioritised, SeeRRI suggests a three-step process:

- To co-define the regional challenge with the quadruple helix actors. For each of the challenges, a promoting group is assembled to coordinate the work and, in RIS3 terminology, the entrepreneurial discovery process. Future-looking workshops in which the actors pose and analyse scenarios and alternative future visions are crucial to this process.
- To co-design the multiactor regional plan or shared agenda to address the challenge and work towards the shared future vision. Identifying and analysing the direct and indirect, desired and undesired impacts on the environment, the territory and specific groups are essential in this process.

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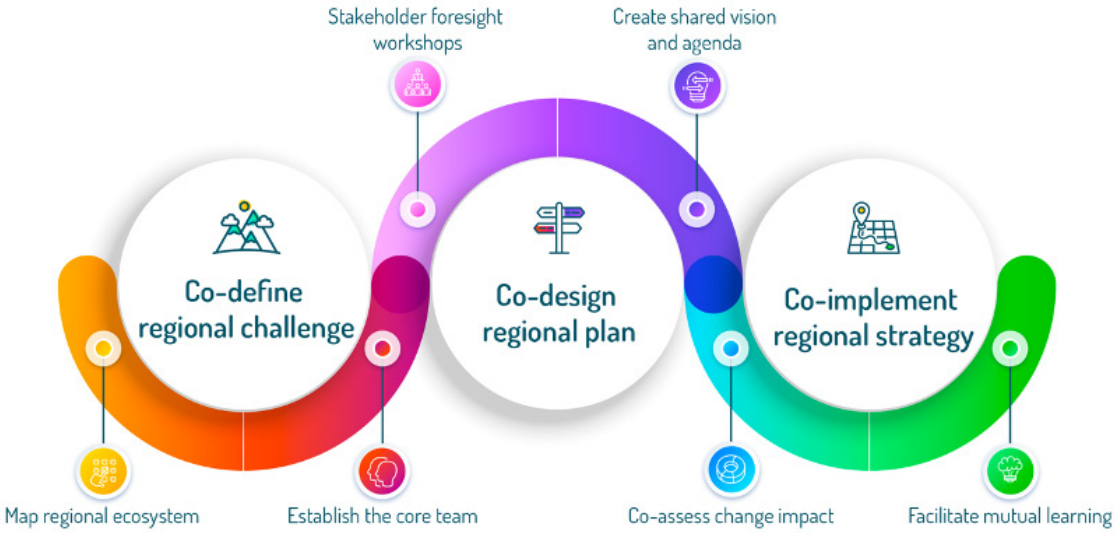
- To implement the shared strategy or agenda, with a particular emphasis on monitoring and learning in order to understand how the actions contribute to addressing the challenge and adapting the strategy or shared agenda in order to maximise its impact.

IMAGE 2. SEERRI APPROACH TO BRING RRI INTO RIS3



Source: SeeRRI Project

Implementation of the approach varies by region and particularly by the thematic area and characteristics of the challenge, the people and the institutions involved, and the region's institutional organisation and participative culture. In Catalonia, this approach is based on the shared agendas methodology, which is explained in section 2.2.

The two other territories in the SeeRRI project are Nordland in Norway and Lower Austria.

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IMAGE 3. PRESENTATION OF THE CHALLENGES OF THE THREE TERRITORIES IN THE SEERRI PROJECT

Source: SeeRRI Project. Designed by Mario Magaña at the Bologna workshop in September 2019

European projects like SeeRRI are essential in promoting experimentation with new approaches and methodologies. Therefore, they allow the quadruple helix stakeholders in a territory (public administration, academia, business community and civil society) explore, test and collectively determine which public policies, technologies and processes and alternative practices can provide fair, sustainable responses to the shared challenges. Within this context, it is crucial to create spaces for experimentation where regional actors can create, test and show building to the current ones by building prototypes and demonstrators that provide solutions to specific challenges.

2.2. Shared agendas for sustainability and social change

The Catalan Government and the UAB have partnered in the SeeRRI project to develop and test the shared agenda methodology for sustainability and social change in the B30 territory as a tool for coalitions of regional actors to address shared challenges.

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These agendas are based on collaboration among public administrations, companies, civil society and academic institutions (universities, research and technology centres and vocational training schools) to understand and manage the challenges and problems within their territory from a holistic, dynamic perspective, bearing in mind the global context, long-term effects and direct and indirect impacts. Experimentation and the quest for innovative, transformative solutions generating shared value in the territory (that is, generating social or environmental value, in addition to economic value) are the core features of shared agendas, and this is where the participation of universities is particularly essential to accelerating the transition towards more sustainable and inclusive (that is, more responsible) development pathways.

Despite the fact that the specific configuration of shared agendas depends on the challenges, the territory and the actors involved, we can highlight the following common features:

- They focus the action on change, transformation and the collective impact sustained over time.
- They are based on inter-sector cooperation and the generation of shared knowledge among public administrations, academia, companies and civil society to understand and manage complex problems from a holistic, dynamic perspective, bearing in mind long-term effects and direct and indirect impacts.
- They are adaptive strategies which actively respond to unexpected effects, developments, successes and failures. Experimentation, monitoring and strategic learning are key aspects of shared agendas.
- They explore alternative routes, try to predict what systemic effects long-term actions will cause, evaluate the results of actions in order to learn and integrate the lessons learned into the actions.
- They are organised according to demand, to respond to specific needs and problems of groups in the territory, through the design of solutions. They include, from the beginning, groups affected by the problems they address, but they also go beyond this initial goal in

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order to reproduce or scale up successful solutions and link them to more global strategies and agendas, such as EU research and innovation missions As shown in image 4, shared agendas are articulated into three steps which are coherent with the methodological framework defined by the SeeRRI project.

- They have their own governance model, which includes actors in the territory that are relevant in the field of the challenge and the problems they generate.

As shown in image 4, shared agendas are articulated into three steps which are coherent with the methodological framework defined by the SeeRRI project.

IMAGE 4. SHARED AGENDAS FOR SUSTAINABILITY AND SOCIAL CHANGE

Source: adapted from The articulation of shared agendas for sustainability and social change

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The goal of the first step is to work with the actors to lay the groundwork needed to articulate the shared agenda. This involves:

- Delimiting the challenge in the territory.
- Identifying the key actors committed to change and establishing an initial advocacy group.
- Co-developing a shared future vision.
- Co-developing a shared vision of the current situation, the problems and their causes.
- Outlining the opportunities (the leverage points in the system) where action can be taken and the hypotheses on the expected impact that can eliminate the barriers and dynamics that prevent progress towards the future vision or accelerate positive dynamics that already exist.
- Defining a preliminary governance model.

The second step focuses on co-designing and implementing solutions. In this step, it is essential to generate meeting spaces where the regional actors can collaborate to co-design the possible solutions, implement them, learn from them and generate collective knowledge.

The third step revolves around transformation and social change, that is, achieving a collective impact that is sustained over time and contributes to accelerating the transition towards sustainability.

The shared agendas concept and methodology has been co-developed in three pilot projects in Catalonia, one of which is the B30 shared agenda for zero waste. The other two are the Biolab Ponent and the Bages shared agenda. In the period 2014-2020, RIS3CAT has promoted these agendas through competitive calls for Territorial Specialisation and Competitiveness Projects (abbreviated PECT).

Another line of work launched by the Government of Catalonia in 2020 explores how the transformative innovation policy framework promoted by the Transformative Innovation Policy Consortium (TIPC) can reinforce the narrative, methodology, efficacy and impact of shared

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agendas and the RIS3CAT to address the SDGs. In 2020 the Government organised a series of workshops with TIPC (the Universities of Sussex and Utrecht and the CSIC-INGENIO Research Centre) for the actors engaged in shared agendas.

3. THE UAB'S CONTRIBUTION TO AN RRI ECOSYSTEM

The UAB is the main actor in the B30 research and innovation system and therefore a key stakeholder in transforming the territory's research and innovation ecosystem. The UAB works in conjunction with other regional actors, and it is following RRI principles to spearhead the transition towards a smart, sustainable and inclusive model of sustainable development that is fully aligned with the RIS3CAT vision and the shared agendas methodology.

Within the SeeRRI project, the UAB has worked on three complementary and closely interrelated lines:

- Methodologies and tools to promote RRI (research and innovation geared at territorial challenges).
- Pilot project to articulate a shared zero-waste agenda as part of the SeeRRI project.
- Governance mechanisms and collaborative workspaces.

3.1. Methodologies and tools to promote RRI

In recent years, the UAB has been exploring and developing methodologies to gear research and innovation to the territorial challenges and thus contribute to more sustainable, inclusive and fair development pathways. The UAB is doing so within different projects and initiatives that mutually reinforce one another and generate synergies and complementarities.

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3.1.1. Ideas Generation programme

The goal of the UAB's Ideas Generation programme is to foster the entrepreneurial spirit and culture of innovation and to support research staff in training at the UAB to model ideas based on the challenges proposed by society. The programme's goal is to encourage researchers to work with companies, administrations and civil society to ensure that research reaches society and generates value in the territory. Even though the Ideas Generation programme has traditionally been heavily focused on meeting industry needs, in SeeRRI this methodology is applied to challenges that are important to the territory. For this reason, during the second half of 2020, the "Ideas Generation in the Circular Economy and Industrial Symbiosis" programme was held, which is explained in greater detail in section 3.2.

3.1.2. Citizen science

In an RRI environment, science and the research and innovation process have to include citizens in all phases: identifying and defining the challenges, collecting and analysing the data, designing the project, raising awareness and disseminating and assessing the impact. Citizen science projects are extremely important within this framework because they generate new knowledge with citizens' active participation in research. Citizen participation can be: (from less to more): 1) in the collecting or processing data; 2) in interpreting the data; 3) in defining the challenges, problems and objectives and collecting data; and 4) in co-designing the research project with the scientists in relation to the areas where they have a direct impact on citizens.

The use of the Internet (and particularly mobile phones) and the social media have made it much easier for citizens to participate in science. There is a very broad consensus that citizens' involvement in research is crucial in understanding the systemic challenges and developing more effective responses to society's most pressing challenges. In the 21st century, citizens are a driver of transformative research and innovation to work towards more sustainable, inclusive and fair development pathways and societies.

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In the UAB's strategy, intensifying the dialogue between science and society is a goal in itself and has become the common thread reinforcing the UAB's involvement in and contribution to the challenges and problems that most concern the regional actors and especially citizens.

As part of this strategy, the UAB is participating in two European projects in the SWAFS-Science for and with Society programme starting 2021 which promote the integration of citizen science into the university's policies and strategy: the SMART-ER (Smart European Regions) and INCENTIVE (Establishing Citizen Science Hubs in European Research Performing and Funding Organisations to Drive Institutional Change and Ground Responsible Research and Innovation in Society).

The UAB is also participating in the Catalan cluster in the European TRANSFORM project. In this project, the Government of Catalonia is partnering with research entities and citizen science laboratories with the goal of co-creating and experimenting with new methodologies to incorporate responsible research and innovation and especially citizen science into RIS3CAT. The activities of the Catalan cluster focus on exploring, through a reflection group and the implementation of pilot projects, how participatory strategies and citizen science methodologies can be incorporated in public policies, in order to address the SDGs and challenges that concern citizens.

3.1.3. Education committed to society's challenges

In the past decade, a broad consensus has emerged on the urgent need to provide effective responses to global challenges like climate change, which have taken shape in the urgency of working towards the 17 SDGs defined in the Agenda 2030.

Within this context, the Education 2030 agenda is promoting the integration of education for sustainable development into educational systems and lifelong learning as a strategy for achieving the SDGs. From the earliest stages to education and lifelong learning, students must be trained to acquire the knowledge, skills, attitudes and values that citizens need to have productive lives, understand the complex world in which we live, take well-grounded decisions and play active roles both locally and globally to deal with the global challenges and contribute to building a sustainable future.

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Education for sustainable development represents a shift from teaching to learning. It calls for a pedagogy focused on the development of skills through active, action-oriented and transformative learning that fosters participation and collaboration, problem orientation and interdisciplinarity.

Schools and universities can create learning contexts based on real challenges in society by promoting local, national and international alliances which involve different actors (companies, NGOs, public entities, etc.). These alliances offer students the chance to take actions for sustainable development that lead them to question and change their vision of the world and prepare them for disruptive thinking and the collaborative creation of new knowledge.

Within this framework, the UAB is participating in the ECIU University project coordinated by the ECIU (European Consortium of Innovative Universities) alliance and financed by the European Union (via the Erasmus + programme), which is based on the premise that through research and education, universities have the capacity to become a driver for social change and transformation. The project is developing and testing a new pedagogical approach to higher education by constructing a learning and educational process based on real-life challenges. Bachelor's and Master's students gear their programmes towards meeting regional challenges with the support and mentorship of research staff. The goal of this approach, which entails a profound change in the university education system, is to improve the processes of acquiring and developing the knowledge and skills needed for a more sustainable, inclusive and fair society.

Similarly, the UAB is also participating in the UCityLab Project, which is promoting a pilot project in the Covadonga neighbourhood of Sabadell to create a new space for experimentation and co-creation where solutions to the city's challenges can be tested: the Covadonga Urban Lab. This urban laboratory is an open environment where citizens can imagine and test solutions to the social, urban and environmental challenges in the Covadonga neighbourhood and in Sabadell in general. The goal is to generate collaborative dynamics among residents, research staff and UAB students. The challenges identified are assigned to Bachelor's students as research projects.

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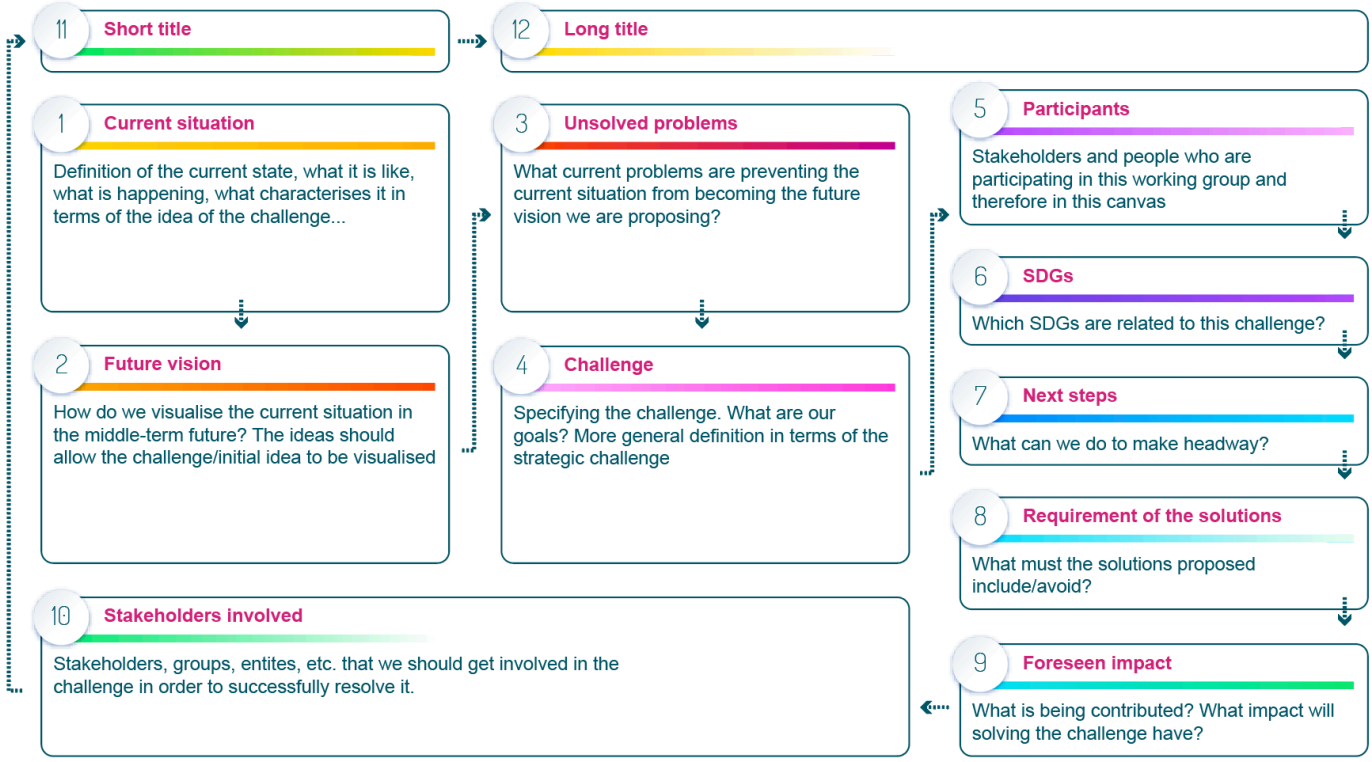
As the project is unfolding, a canvas model has been designed to define the challenges using a systemic approach, as shown in Image 5.

IMAGE 5. CANVAS MODEL TO WORK ON CITY CHALLENGES



Source: adapted from UAB

The document Guidelines for getting post-compulsory and higher education involved in regional agendas geared at the SDGs (to be published in the RIS3CAT Monitoring Collection), includes examples of the methodologies developed by the UAB.

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3.2. Shared zero-waste agenda within the SeeRRI project

To promote RRI in the B30 territory, the UAB is a shared zero-waste agenda, which pool the efforts of different actors to meet one of the territory's systemic challenges: making the transition to the circular economy.The agenda is based on a shared vision for the B30 territory, which has been defined as follows:

> The B30 is a highly competitive, inclusive territory with a high quality of life which through its decarbonised, waste-free economic development model creates wealth based on the resources it has, generates and receives.

The SeeRRI project has focused on working with the regional actors on two key factors in articulating this shared agenda (through workshops, meetings and co-creation activities):

- Understanding the systemic challenge and laying the groundwork for collective action.
- Identifying and promoting regional actions and initiatives that can be part of the shared agenda.

The methodology of SeeRRI and shared agendas puts a lot of emphasis on comparing the system and the current situation with the shared vision of the future, that is, a vision of what the system will be like if the challenge is successfully addressed, and the current problems no longer exist. This comparison reveals the contradictions of the current system. Bringing these contradictions to the fore is crucial to getting the actors aware that they are part of both the problems and the solutions, and that their actions interact with those of the other actors, so if they work in coordination, they can have a greater influence and impact on the system.

In this analysis, it is very important to bear in mind the global trends (legislative changes, technological advances, sectors, emerging activities, changes in consumer preferences, new financing opportunities) and the assets and specificities of the territory (regulation, capacities, attitudes, etc.) in relation to the challenge.

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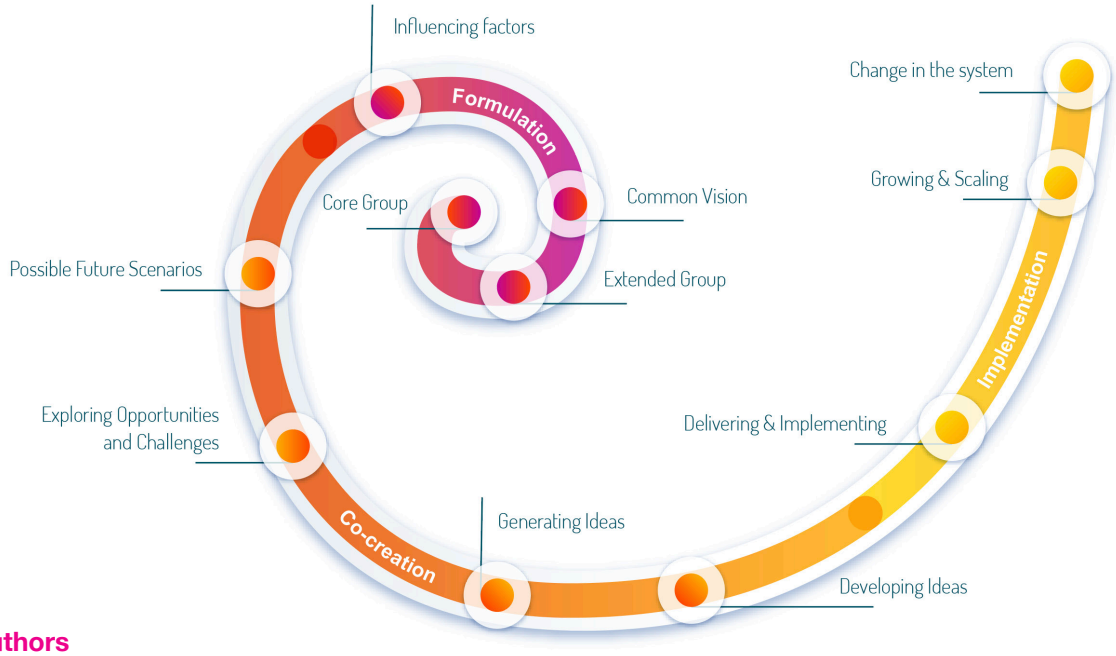
The SeeRRI approach promotes a dynamic, non-linear process of collective empowerment which is illustrated in Image 6.

IMAGE 6. PHASES IN BUILDING THE SHARED AGENDA OF THE B30



Source: Authors

The workshops that have been held with actors from the B30 within the SeeRRI project are designed to work on all three phases of the SeeRRI and shared agendas methodologies. That is: formulating a challenge based on a shared vision, engaging in a co-creation process to identify problems and solutions, and implementing the solutions. Image 7 shows which workshops address each of the phases in the process. Sections 3.2.1. – 3.2.4. explain the approach and content of each of the workshops held within the project.

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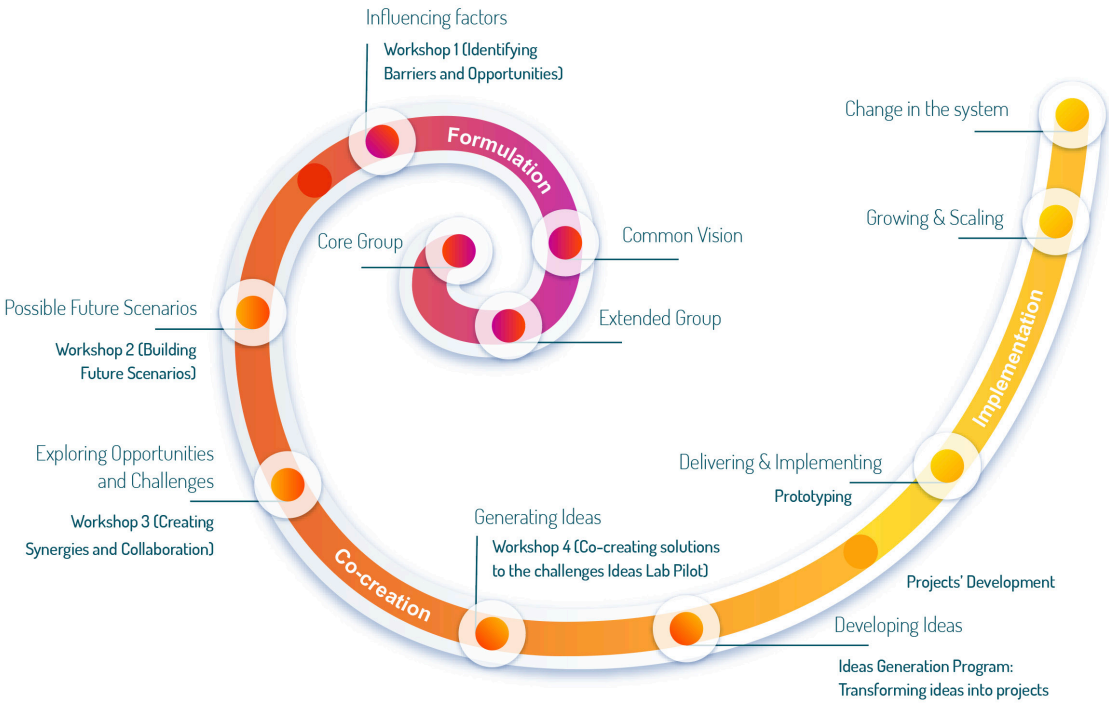
IMAGE 7. WORKSHOPS FOR THE B30 SHARED AGENDA



Source: Authors

3.2.1. Workshop to identify obstacles and opportunities

Date: 17 December 2019

Venue: Universitat Autònoma de Barcelona

Number of participants: 26

This workshop shared the previous analysis of the current situation of waste in the B30 territory and the future vision. The factors and forces or dynamics in the system that can contribute or block advances towards the shared vision (facilitators or inhibitors) were identified with the actors that participated in it. These factors can include people, trends, events, norms, beliefs, etc., which are connected to each other via causal relations that give rise to patterns or dynamic loops. These factors and dynamics can become positive forces (facilitators) towards achieving the shared vision or negative forces (inhibitors) which hinder the transformation in the desired direction.

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IMAGE 8. SEERRI WORKSHOP ON 17 DECEMBER 2019 AT THE UAB

The participants in the workshop worked on the specific challenges in the B30 territory related to zero waste:

- The importance of having micro-data on the resources in the territory and the role of technologies in collecting and visualising data.
- The role of universities and labs in training people and creating new professional profiles to manage the change.
- The challenge of scaling industrial symbiosis initiatives and the role of industrial sites.

The debate identified multiple factors and forces that can significantly influence the transition towards a zero-waste strategy in the B30 as facilitators or inhibitors of the changes in the desired direction, as shown below:

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TABLE 1. FACTORS THAT INFLUENCE THE TRANSITION TOWARDS ZERO WASTE IN THE B30

Dimensions	Factors
Social	• Consumer behaviour (people, companies, public administrations, etc.) • Culture of collaboration in the region • Awareness and systemic vision of the actors in the region • Education, training and competences • Resistance to change • Communication
Technology	• Structure of industry in the region • Research and innovation with society and for society • Companies' and the public administration's capacity to absorb technologies • New technologies: big data, blockchain, IoT, artificial intelligence, etc.
Economic	• Business models • Tax system • Public support (subsidies, public innovation procurement, etc.)
Environmental	• Efficient use of resources • Recycling infrastructures • Recyclability of materials • Recycling markets
Legal	• Laws on waste • Standards and regulations
Governance	• Agendas shared by stakeholders in the ecosystem to address systemic challenges

Source: Authors based on the results of the workshop

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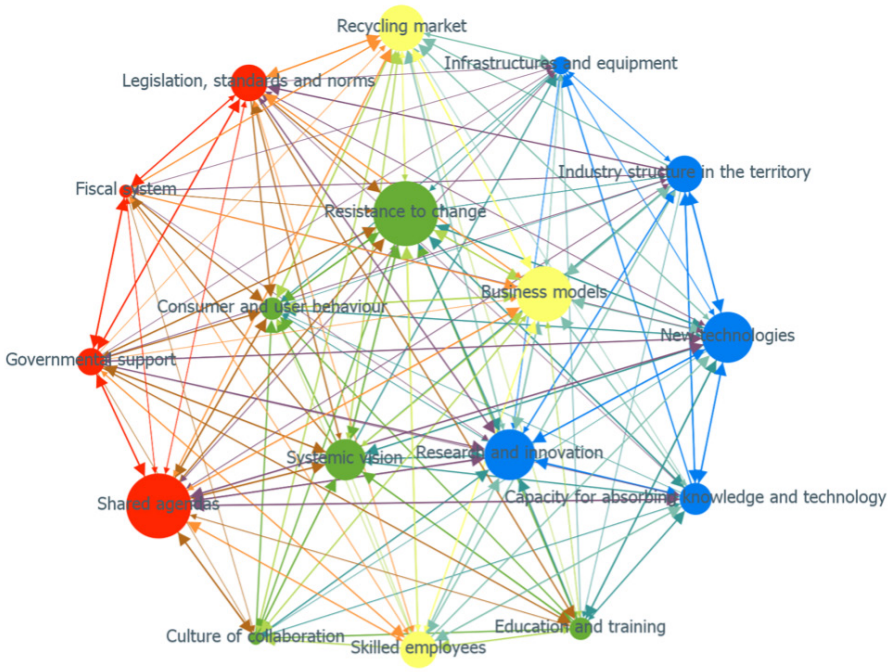
After the meeting, 20 key factors that had emerged in the debate were identified and chosen with the SeeRRI partners. Not all the key factors identified are equally important, and the majority are closely interrelated due to cause-effect relationships which are not one-way. The analysis of the connections among the different factors using the methodology provided by the project partners (Austrian Institute of Technology, AIT) were reproduced in a graphic that illustrates the relative importance of each of the factors and the multiple interrelations associated with the goal of zero waste.

IMAGE 9. DIMENSIONS AND FACTORS THAT DETERMINE THE POSSIBLE FUTURES WITH REGARD TO ZERO WASTE



Source: SeeRRI Project, developed by the Austrian Institute of Technology (AIT)

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3.2.2. Workshop to analyse possible future scenarios

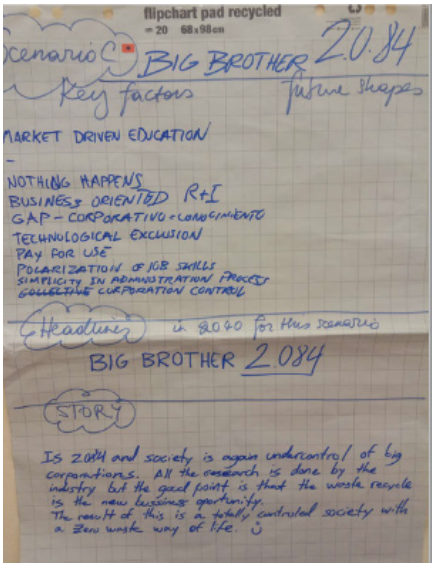
Date: 14 February 2020

Venue: Casa de la Convalescència, Barcelona

Number of participants: 23

The workshop held on 14 February 2020 focused on analysing how the combined evolution of the key factors identified in the previous session could shape quite different future scenarios. The STEEPLE methodology was used to illustrate the different future scenarios.

IMAGE 10. RESULTS OF THE WORKSHOP EXERCISES ON FUTURE SCENARIOS



The debate revolved around two quite opposite future scenarios which are compatible with a decarbonised, waste-free economic development model that creates wealth using the resources that it has, generates and receives.

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"BIG BROTHER" OR TECHNOCRATIC DICTATORSHIP SCENARIO: Society is under the control of large multinational companie. Industry does all the research. The technologies allow great control of society and the economy is 100% circular, since the waste recycling is a business.

OPEN, UNITED, PARTICIPATIVE SOCIETY SCENARIO: The road ahead towards a circular economy is grounded on a furtherance of open, participative democracy by boosting citizens' awareness and empowerment so they feel responsible for their environment and work collaboratively to promote more sustainable, inclusive and fair development pathways. This society's progress is measured not by economic growth but by the quality of life of people and the environment in which they live.

3.2.3. Workshop to generate synergies and new collaborative dynamics

Date: 16 July 2020

Venue: Virtual

Number of participants: 22

This workshop had two goals. The first was to share information on different initiatives related to zero waste which the actors associated with the SeeRRI project are promoting in the territory. In addition to these initiatives, the second goal was to reflect on how they can connect to become part of a shared zero-waste agenda in the B30 territory and thus mutually reinforce one another, pool the efforts of different actors and generate new collaborative dynamics in the territory which contribute to the transition towards more sustainable and inclusive development pathways and zero waste. The initiatives are the following (some of them were explained above in section 3.1.):

- Pilot project in Granollers to generate collaborative dynamics in the sphere of the circular economy among vocational training schools, public administrations and companies in the city.

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- Circular economy pact in the textile sector promoted by the Government of Catalonia, which encourages administrations, companies, research and innovation stakeholders and civil society to pool their efforts to accelerate the transition towards circular economy.
- Ideas Generation programme of the UAB.
- Covadonga Urban Lab, which gets the academic community and citizens involved in co-creating agendas in the process of transforming the city based on its challenges.
- TRANSFORM project, which is promoting a pilot project in the area of municipal waste management in the B30.

Multiple opportunities for collaboration and connection among different initiatives were identified in the discussion.

3.2.4. Workshop series to develop innovative solutions

The goal of this workshop series is to identify specific problems related to zero waste in the territory which can be worked on in academia. During the second half of 2020, the "Ideas Generation in the Circular Economy and Industrial Symbiosis" programme was held. All the working sessions were virtual due to COVID-19.

For this programme, six entities of the B30 territory posed 10 challenges to the participants:

- Optimisation of current waste management and treatment processes to maximise materials recovery
- Reuse of plastic containers
- Quest for solutions to increase triage in the textile sector
- Recovery of the urban and forest biomass
- Valorisation of surplus food
- Revalorisation of coffee resources (jute bags, chaff and grounds)
- Recovery of industrial wastewater

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- Recovery of sludge from water treatment stations
- Recovery of materials from landfills using mining techniques (landfill mining)
- Integration of all the by-product exchanges to maximise and scale the symbiosis among SMEs

The first idea laboratory workshop, in which 41 people participated, explored the social perception of the challenges; defined a shared vision of the challenges; generated ideas; and explored, identified and validated possible avenues of research and innovation relevant to society.

Based on this first workshop, 23 people (primarily post-graduate students and researchers, as well as entrepreneurs) participated in the Ideas Generation programme, a practical training programme at the UAB. The 23 participants got into multidisciplinary groups to explore and develop ideas based on research and innovation and business models to address the challenges posed.

The participants chose 4 challenges: optimisation of current waste management and treatment processes to maximise materials recovery; recovery of forest biomass; revalorisation of coffee resources; and recovery of industrial wastewater.

Within the workshops, the participants developed five proposed solutions and business models:

- **Nanomel:** Wastewater and sludge treatment with melanine nanoparticles.
- **Silvin:** Production of antioxidants for cosmetics from coffee chaff.
- **SIVORG:** Production of biogas from treating industrial wastewater from the food industry.
- **Wabire:** Bioproduction of glycolic acide using forest biomass.
- **BIOTEM:** Revalorisation of organic bioplastics.

At the end of the programme, on 17 December 2020, those projects were publicly presented and, supported by municipalities or other interested entities, will be developed.

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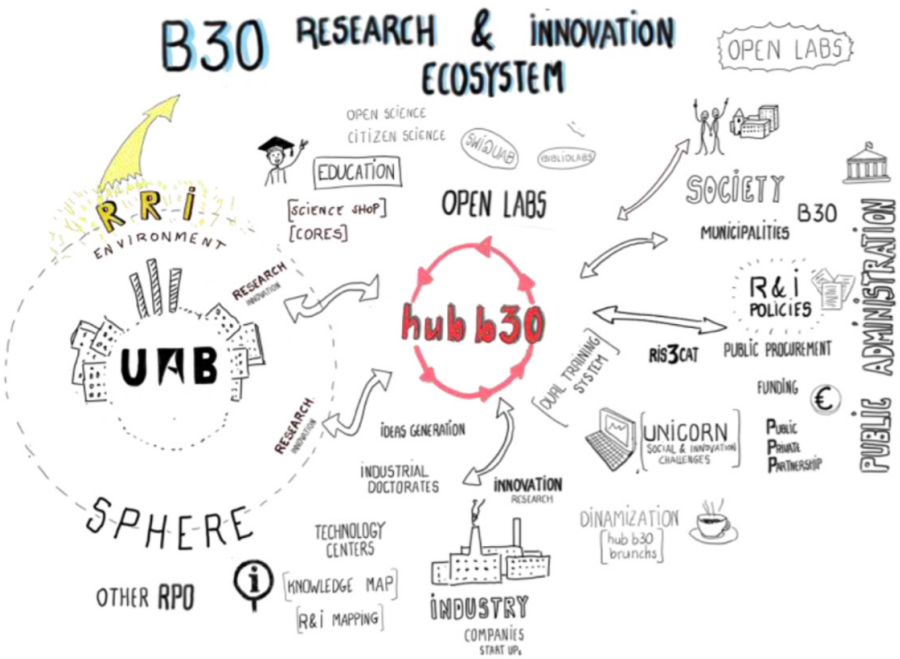
The application (and adaptation, if needed) of the methodology to develop ideas based on the territorial challenges is a practical example of how universities can partner with public administrations, companies and civil society to meet the territorial challenges via RRI, generating new dynamics that strengthen the ecosystem and make it more sustainable.

3.3. Governance mechanisms and collaborative workspaces

As mentioned above, one of the key elements in RRI ecosystems is that they are equipped with structures, mechanisms and spaces that promote a systemic vision of the territorial challenges and the collaboration of actors to meet those challenges. Within the SeeRRI project, via the pilot project to co-design and implement the shared zero-waste agenda, the UAB has launched a process of identifying and reinforcing the existing structures and mechanisms in the territory and at the university that facilitate the articulation of shared agendas, as presented below.

IMAGE 12. REPRESENTATION OF THE RESEARCH AND INNOVATION ECOSYSTEM IN THE B30



Source: Own elaboration

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3.3.1. The HubB30 initiative

To articulate the ecosystem, it is essential to have a research and innovation structure or platform that generates an environment of collaboration among the main actors and facilitates governance. In 2018, the UAB launched the HubB30 initiative, a multisector platform that promotes research and innovation in the B30 territory by interacting with actors to identify and work on the territorial challenges, co-design shared visions of the future and promote collective action. The mission of the HubB30 is to generate participative dynamics with the quadruple helix which promote the territory's industrial transition by identifying challenges and proposing solutions. The HubB30, which is promoted by the leading research and innovation actors in the B30 in conjunction with the Association ÀmbitB30 (which includes the 23 municipalities) plays a key role in the territory in sharing knowledge and promoting the collaboration of the actors by identifying opportunities for collaboration.

Since 2019, the HubB30 has promoted two major initiatives:

Innovation brunchs: Multisectoral gatherings to promote research and innovation in priority fields in the territory by presenting the state of the art and the leading trends and disruptive innovations, generating debate and promoting debate and reflection.

Innovation mornings: Thematic multisectoral workshops to work on the social challenges of the territory. These workshops encourage reflection and collective work using co-creation and design thinking methodologies.

3.3.2. The HubB30 project, beyond circularity

With the support of the RIS3CAT competitive call for Territorial Competitiveness Specialisation Projects (abbreviated PECT in Catalan) six entities of the B30 territory (the UAB, the Cerdanyola del Vallès Town Hall, the Mollet del Vallès Town Hall, EURECAT, ESADECreàpolis, the UAB Research Park Foundation and the AmbitB30 Association) are promoting the "HubB30, Beyond Circularity" project. This project is a key element for articulating the governance of the B30 RRI ecosystem.

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One of the main objectives of this project (which has a budget of approximately 5 million euros, co-financed with the ERDF Operating Programme in Catalonia) is to pool the efforts of the actors around the shared RRI agenda towards zero waste, which is promoting the transition towards the circularity of the productive system. This project is essential in continuing the work of SeeRRI and consolidating RRI as a driver for the transition of the territory towards more sustainable, inclusive development pathways.

3.3.3. The UAB OpenLabs network

The development of collaborative responses to the territorial challenges requires an infrastructure of collaborative workspaces, spaces where the actors can meet, share knowledge and work jointly to develop effective responses to the complex challenges via shared agendas.

Within this framework, the UAB's UAB OpenLabs network project has taken on a new dimension, given that these laboratories or spaces for collaborative innovation are essential parts of responsible research and innovation ecosystems. The objective of the UAB OpenLabs network is to create and promote spaces of participation and co-creation which produce new environments for experimentation, innovation and demonstrations of new technologies and methodologies. The UAB is promoting a network of coordinated spaces located all around the B30 territory which are fostering participative processes and co-creation. There are two different types of laboratories. The first are fab-labs, where user-centred solutions can be quickly prototyped. The second are laboratories geared towards generating new productive models based on user-centred open innovation processes (living labs, social labs).

The UAB OpenLabs network also includes other meeting spaces which facilitate the active involvement of citizen science. The most illustrative example is the Bibliolab ISC2 project launched in 2018, which is helping transform the libraries in three towns along the B30 (Sabadell, Sant Cugat and Cerdanyola del Vallès) to align them with new initiatives promoting the active role of a citizenry that generates knowledge and co-creates innovative social solutions.

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The goal is to promote libraries as spaces of learning and participation where researchers and citizens can address the territorial B30 challenges.

3.3.4. The Unicorn Challenges Platform

The UAB is developing a digital challenges platform that poses the challenges in the B30, develops collaborative innovative responses with the regional actors and seeks the financing to develop and, if possible, implement them.

The Unicorn Challenges Platform,which is in the pilot phase, is a basic infrastructure project to implement the methodologies described in section 2: to visualise the challenges that most concern local actors; to work on the definition of systemic views of the challenges; to work on the articulation of shared agendas that bring together the efforts of diverse actors to address the challenges. As mentioned above, shared agendas for sustainability and social transformation are a key element in an RRI ecosystem. Likewise, having a platform that incorporates a wide variety of challenges relevant to society is a key to orient universities (and secondary and vocational school) towards learning and training processes based on real-life challenges and training people who are more committed to their environment and to the Sustainable Development Goals.

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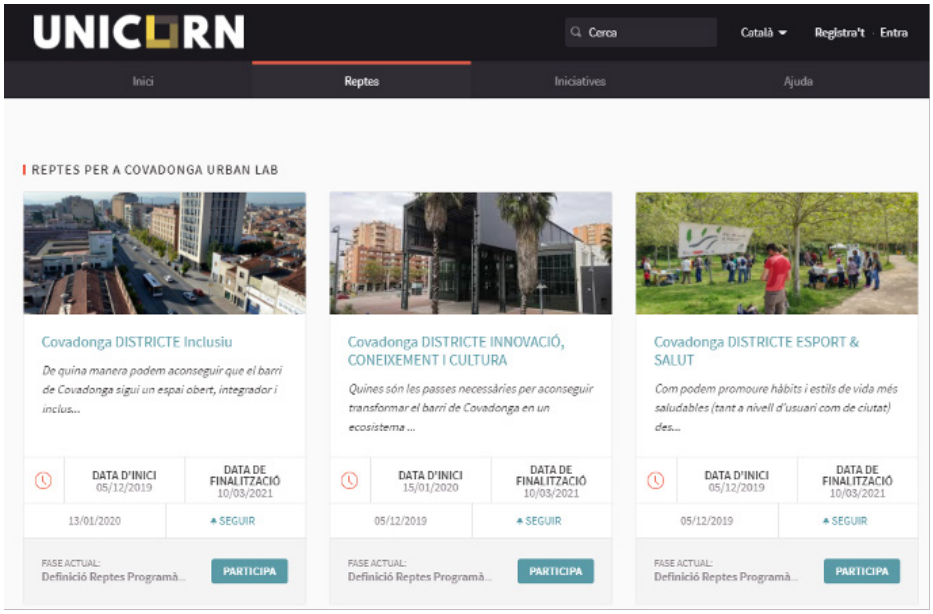
IMAGE 13. VISUALISATION OF THE CHALLENGES ON THE UNICORN PLATFORM



Source: https://unicorn.uab.cat/

The Unicorn Platform project has synergies and complementarities with the Government of Catalonia's project to develop a challenges model on the Participa Gencat portal, which can serve as a base and model for other entities to easily adapt it and to create their own challenges portal. The Government of Catalonia is also developing a project to visualise the challenges and solutions on the challenges platforms of different territories within Catalonia.

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4. BEYOND THE SEERRI PROJECT

As stated in the introduction, the SeeRRI project, and more specifically the pilot project undertaken in the B30 in 2019 and 2020, have attempted to address to core issues:

- How can RIS3 promote RRI as a means of addressing the SDGs and promoting pathways for a more sustainable, inclusive and fair development?
- How can the UAB contribute to a research and innovation ecosystem more responsible and sustainable, which addresses the SDGs and promotes pathways for a more sustainable, inclusive and fair development?

With regard to the first question, it was found that there is a need for new narratives, new governance and participation mechanisms and new methodologies to articulate shared RRI agendas addressing territorial challenges in more effective ways by contributing to more sustainable and inclusive pathways. Therefore, RIS3 should:

- Shift from a sectoral and technological prioritisation to prioritising the most relevant challenges to the territory and to the people who live there.
- Adopt systemic, dynamic approaches inspired by the transitions towards sustainability within the Transformative Innovation Policy framework.
- Integrate all four dimensions of RRI on the level of strategy, instruments, projects and monitoring and assessment, incorporating the current and future environmental and social costs and benefits, in addition to the economic ones.
- Reorient the instruments that support technology transfer towards RRI, that is, towards research and innovation with and for society. RRI is grounded in the collaboration of the quadruple helix actors to address shared challenges in dynamic processes that range from generating ideas to implementing solutions in real environments.
- Articulate discovery processes (in RIS3 terminology, entrepreneurial discovery processes) to define the priorities of the projects and actions. These processes should combine

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bottom-up and top-down approaches (through shared agendas) that promote new business models and alternatives to the practices in the current system which are environmentally and socially unsustainable. This discovery process should reinforce the participation of the actors from the quadruple helix and place at the core of RIS3CAT experimentation with alternative practices and technologies that contribute to the more sustainable, inclusive and fair future.

- Use monitoring approaches focused on building collaborative networks and assessing transformative impacts. Assessment approaches that grasp how RRI contributes to addressing the SDGs and promote more sustainable, inclusive and fair development pathways must be developed.

With regard to the second question, it was found that the UAB is a key actor in working towards an RRI ecosystem in the B30, that is, a research and innovation system that is more committed to the territory and the needs of the people who live there and to the transition to more sustainable, inclusive and fair development pathways. SeeRRI and the pilot project have contributed to reinforcing the coordination of mechanisms that promote the university's collaboration with other actors to jointly address the territorial challenges and has also contributed to bolstering the role of the UAB and RRI as driver to accelerate the transition to sustainability. Direct collaboration between university and territorial stakeholders to address shared challenges allows to overcome the concept of technology transfer that is still the main mechanism to transfer knowledge from universities to society.

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5. ANNEX. SYSTEMATIC ANALYSIS OF THE ZERO-WASTE CHALLENGE IN THE B30

Xavier Ariño, Tatiana Fernández and Verónica Kuchinow

The discussion and working dynamics with the actors in the B30 territory as part of SeeRII in 2019 and 2020 were undertaken based on a previous systemic analysis of the challenge of zero waste in the B30, in which territorial actors also participated. The analysis did not strive to be exhaustive; instead, the goal was to highlight the multiple factors that have to be borne in mind when working on the challenges and promoting systemic transformations. The sections below explain:

- The selection of the zero-waste challenge
- The shared vision of the future
- The global context
- The current situation in the B30
- The main obstacles to advancing towards zero waste

5.1. The selection of the zero-waste challenge

The shared agenda focuses on one of the main systemic challenges in the B30 territory, namely making being a highly competitive, inclusive territory with a high quality of life compatible with a decarbonised, waste-free economic development model which creates wealth via the resources it has, generates and receives.

The work with the territorial actors has focused more specifically on the goal of zero waste, which is shared by many actors in the territory and meets a set of condition that make it ideal for SeeRRI:

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- The goal of zero waste is closely tied to the Sustainable Development Goals (SDGs) and to the European Union's strategic objectives; therefore, it is a goal shared by many territories. This is extremely important, given that one of the goals of SeeRRI is to generate methodologies and cases of best practices that can be adapted to other territories.
- The global trends to lower waste, framed within the climate emergency, the new European Green Deal and legislative changes which are providing incentives for the transition towards the green and circular economy, are generating challenges and opportunities of which public administrations, companies, universities and research and innovation centres and civil society are not fully aware. Becoming aware of these challenges and opportunities may serve as a lever to promote new collaborative dynamics among the regional actors and to promote RRI and more environmentally responsible behavioural patterns.
- The B30 territory is the most important industrial agglomeration in Catalonia. It is a territory with a great deal of industrial land, a high population density and a delicate balance between socioeconomic development and sustainability. This territory generates many resources which are squandered. There is broad leeway for working with the actors in the territory to explore innovative formulas that generate economic, social and environmental value by capitalising on the resources available in the territory which are currently not used.
- There is a large number of innovative multi-actor initiatives in the B30 territory promoting the circular economy. However, these initiatives are often not coordinated with one another and do not have sufficient critical mass or the allies needed to activate processes that could transform the current system. A systemic vision which could provide coordinated responses to shared challenges from a variety of spheres and institutions is lacking. The shared agendas methodology should promote the development of new collaborative dynamics among the actors in the ecosystem based on both existing and new initiatives, along with more effective systemic responses to work towards the goal of zero waste with the active participation of the quadruple helix actors.

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- The UAB is steadfastly committed to the goal of zero waste, and in recent years it has developed a network of alliances with other actors in the ecosystem, especially local entities, to work together in this direction. Therefore, the UAB has the capacity to spearhead a shared zero-waste agenda in the B30 territory by pooling the efforts of a wide variety of actors in order to have a systemic impact.

5.2. The shared vision of the future

The analysis is grounded upon a shared future vision for the B30 territory:

> The B30 is a highly competitive, inclusive territory with a high quality of life which through its decarbonised, waste-free economic development model creates wealth based on the resources it has, generates and receives.

This shared vision is grounded upon an RRI ecosystem in which all the stakeholders comprising it (public administrations, universities and research and technology centres, companies and civil society) are committed to this vision and are joining efforts to attain it.

As shown in Table 1, building this sustainable and inclusive research and innovation system requires the engagement of all the actors in the territory.

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TABLE 1. CONTRIBUTION OF THE QUADRUPLE HELIX ACTORS TO A SUSTAINABLE AND INCLUSIVE RESEARCH AND INNOVATION ECOSYSTEM

Local entities

- They support a strong, dynamic productive network that generates economic prosperity and quality jobs in a healthy, environmentally respectful environment.
- They have personnel with the right competences to manage the transition towards sustainability with a systemic vision. The personnel work transversally and with the actors in the quadruple helix to articulate shared agendas that respond to territorial challenges and promote a more sustainable, inclusive development model.
- They monitor and therefore make visible the costs of the externalities of the linear system to turn them into valuable resources and tools like "carbon rights" to redistribute the wealth in a fairer way.
- They affect social and collective awareness of sustainability and the circular economy while building trusting, cooperative relations with local and international stakeholders to ensure stable relations and attract initiatives in the sphere of the circular economy.

Companies

- They work with circular business models geared at generating shared (economic, environmental and social) value.
- They have qualified staff and foster their competitiveness in their quest for the circular economy by incorporating technology (especially digital technologies), developing new business models and exploiting new market niches with high added value.
- They contribute to consumers' awareness of and engagement in the circular economy by bringing to market goods that can be repaired and disassembled and are made with recycled and recyclable materials, and which are also traceable and contain no toxins.
- They are located in efficient, well-managed industrial estates that offer companies value: good telecommunication and transport services; generation of renewable energies in smart grids, both electric and heat and cooling; regenerated water networks; industrial dumps to better use resources; and industrial symbiosis projects.
- They are rooted in the territory and collaborate with the quadruple helix local actors with a clear commitment to more sustainable, inclusive regional development.

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Citizens
• They act responsibly; gain awareness of their role as actors in the ecosystem; purchase durable, repairable goods; and use them throughout their entire service life. • They choose new and better job opportunities in the territory that cannot be outsourced and different levels of qualification. • They have a high quality of life in a healthy environment. • They are aware of their role in the economy and participate in new collaborative, open and participative consumption models. • They are empowered, organise themselves into collaborative structures and participate actively in initiatives in their territory.
Universities and research and technology centres
• They are a key actor in articulating the research and innovation system and in developing, attracting and retaining human talent. • They prioritise research and innovation targeted at solving important regional challenges which have a global impact. • They manage knowledge, train professionals and equip workers and entrepreneurs with the right competences to promote the industrial transition and change in socioeconomic model in the territory. • They have first-rate equipment and infrastructures for researching, designing and prototyping. • They are engaged in responsible research for new solutions and services to improve the use of resources, develop new materials and optimise production and reuse processes. • They facilitate the process of adapting the territories to the new opportunities emerging from global trends by integrating new technologies that transform job markets.

Source: Authors based on the contributions of territorial actors

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5.3. The global context

Climate change and the urgency of evolving towards more sustainable pathways of economic development have driven multiple strategies globally, in Europe, nationally, regionally and locally, as well as highly ambitious goals, such as the SDGs, and the EU's goal to become the first climate-neutral continent in the world by 2050.

Within this framework, the EU is promoting directives and regulations to accelerate the transition towards a circular economy by transforming waste into resources and setting ambitious (and necessary) goals and requirements in relation to collecting waste, recycling, repairs, durability and waste.

This paradigm shift has major implications for all European regions and their productive sectors, and it also generates both risks and opportunities. For an industrial territory like the B30, identifying and understanding trends and working towards the inevitable changes while lowering risks and boosting the opportunities to generate economic, social and environmental value in the territory are essential. Adapting to the new regulatory framework being defined by the EU will require developing recycling technologies, redesigning collection systems, redesigning products to make them easier to recycle, introducing recyclable materials into manufacturing processes and, in short, redefining the value chains in the territory.

Tables 2 and 3 show some of the global trends which are crucial when analysing the current state of waste in the B30 territory and the associated opportunities. Table 2 focuses on the legislative trends related to resource management in the EU, while Table 3 presents global trends in lifestyles and consumption models.

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TABLE 2. MAIN LEGISLATIVE TRENDS IN THE EU AND RELATED OPPORTUNITIES

EUROPEAN REGULATIONS	OPPORTUNITIES
Waste	
The Waste 1 Framework Directive sets recycling targets for 2050: • 70% valoration of packaging waste by 2050 • 65% recycling of municipal waste by 2035 • 10% maximum waste authorised to be taken to landfills by 2035 The Waste 2 Framework Directive stipulates the expanded compulsory responsibility for waste from electrical and electronic apparatuses, unused vehicles and batteries. After 2024, it will also be compulsory for packaging. This expanded responsibility means that producers pay according to the durability, repairability and recyclability of their products, as well as the presence of hazardous and toxic components.	Opportunity to develop a strong recycling industry capable of transforming waste into secondary raw materials in an increasingly stringent market. Waste managers will become recyclers and suppliers of high-quality secondary materials who offer their clients professional services. Opportunity for companies to redesign their products to make them durable, repairable, recyclable and toxin-free in order to respond to the shift in consumer demands.
Plastic	
By 2030, all plastic containers in the EU must be reusable or recyclable. Recycling of plastic containers must increase to 55% by 2030 and 70% by 2050. The EU is developing a quality standard for sorted plastic waste and recycled plastics. The Single-Use Plastics Directive, which bans the use of single-use products manufactured with plastics and oxo-degradable plastic, is framed within this strategy.	Working in conjunction with the manufacturers of plastic products in designing, collecting and treating their products at the end of their life cycle is a huge opportunity for recyclers of plastic waste to go from being waste managers to suppliers of materials, and for them to become an essential part of the resource-efficient economy. Better product design makes it easier to recycle plastics, leading to major opportunities for designers.

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EUROPEAN REGULATIONS	OPPORTUNITIES
Food waste	
The Waste Framework Directive introduced a definition of "food waste" and is forcing the Member States to lower waste in each stage in the food supply chain.	The animal feed industry has a huge opportunity with food waste. Food donations are an interesting market to explore with extremely high social benefits. Preventing food waste yields major savings for families, companies and institutions (like schools and hospitals).
Construction waste	
Even though the construction sector is extremely conservative and changes are very difficult to implement, there is a burgeoning global movement towards sustainable construction which means zero landfill waste and the prioritisation of reusable, recycled building materials.	For materials manufacturers: developing recyclable, reusable products with renewable raw materials that are easy to disassemble. For builders and desigenrs: zero-waste construction, energy efficient buildings with renewable energy sources. For the public administration: encouraging public procurement in licenses and tenders.

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TABLE 3. GLOBAL CONSUMPTION TRENDS AND RELATED OPPORTUNITIES

TREND	OPPORTUNITY
Repair	
The European Commission is exploring and promoting measures to encourage product repairs, bearing in mind that the design of a product, the availability of spare parts and handbooks and tools play an important role in the choice to repair a product or replace it with a new one.	The repairs business will generate new jobs and new business models in the forthcoming years.
Reuse	
With the goals of promoting reuse and second-hand markets, the European Commission is working on a Product Liability Directive to offer legal clarity and assign liability.	The new regulatory framework may promote the development of reuse centres and networks.
Collaborative consumption	
Business models based on collaborative consumption are quickly developing around high-value products thanks to a keen interest from consumers. Some experts estimate that the collaborative economy may add 160-575 million euros to the EU economy.	High economic potential for disruptive collaborative business models around high-value products. The typical products are mobility and flats, but there are vast opportunities for other products such as farm machinery and household appliances like washing machines.

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Commitment to the circular economy	
Consumers generally support the circular economy, but this does not translate into changes in behaviour and consumption. The European Commission is exploring and spearheading measures to supply consumers with more information so they can adopt more responsible consumption patterns.	Companies that choose to provide information on the repairability and durability of their products and to help create affordable repair services may reach more consumers and boost their turnover.

5.4. The current situation in the B30

The current situation in the B30 is analysed from the standpoints of waste generation, the cost of waste, the challenge of valorisation and awareness among the actors. The main conclusions of this analysis conducted and debated with actors from the B30 are the following:

- We throw away many resources (with an economic and environmental impact that has not yet been calculated);
- There is a lack of technologies, companies and instruments to control and trace materials to complete their cycles, starting with waste managers, who should become suppliers of recycled materials;
- There is a dearth of strategies to encourage the product repairability, reuse and design for recycling, and even identifying the "circularity" of products on the market (to help consumers);
- The tax system and legal framework do not facilitate actions to shift towards a circular model;
- There is awareness in companies and actors, but this awareness does not translate into action, and many efforts are needed to promote collaboration;

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- Generally speaking, the culture of collaboration among companies (associations), municipalities, departments and projects (4.0, circular economy, IoT, etc.) is lacking;
- There is a deficit in the training and skill-building of the people involved in the transition process;
- Governance in the territory has to change to make the changes and innovation in companies and markets possible.

5.4.1. Waste

As a consequence of the linearity of our current economic model, a great deal of waste is generated, both industrial and domestic. Almost 8 million tonnes of waste were generated in Catalonia in 2018, approximately half of which is from households while the other half is industrial in origin. Almost 25% of all industry in Catalonia is clustered in the B30 territory, and it also generates approximately 25% of all industrial waste in Catalonia. Therefore, this means that the industries in the territory generate around 1 million tonnes of waste every year. The companies that generate the most waste are in the metallurgical sector, followed by the paper and graphic arts and the agrofood sectors.

The EU estimates that 25-30% of materials declared waste can be recovered. Based on this, we estimate that 700,000 tonnes of materials are thrown out in the B30 every year in the form of non-valorised industrial waste (at least optimally). According to figures from the Catalan Waste Agency, almost 30% of industrial waste in the province of Barcelona is declared ordinary, a mix of non-hazardous waste (comparable to household waste) without any kind of sorting and going directly to the landfill. It can be estimated that around 300,000 tonnes of ordinary waste per year from industries in the B30 go directly to the landfill. Within this portion, there are recoverable materials (wood packaging, cardboard, plastic, etc.) which are usually generated in small amounts that make them unprofitable (in the current models) to collect and sort for recycling. There are also the remains of workers' food and drinks. The remaining industrial waste is comprised of all kinds of packaging and materials specific to the industrial activity (metal, textiles, organic waste, plastics, etc.).

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Industrial waste is the waste with the highest value and the most difficult to keep track of (it is privately managed individually by each company). According to conclusions from the workshop of the SeeRRI project held on 17 December, it is impossible to assess the level of valorisation of materials declared as waste with the current administrative waste management system given that the current management system was not designed with this purpose in mind. That is, we do not know what ends up happening with the waste or the real percentage of valorised waste, but we do know that it is a powerful source of creating new business opportunities and value in the territory.

5.4.2. The cost of waste

A large part of the industrial waste in the territory goes to the landfill to be incinerated or is exported (we estimate around 700,000 tonnes per year). The management of this waste entails a major economic cost for both companies (which have obligations with waste) and citizens (taxes). It also generates soil and air pollution problems, foul smells and congestion around the areas with landfills or incinerators. Only bearing in mind the cost of the landfill fee plus the cost of the landfill and transport (around 60 euros per tonne) of the 300,000 tonnes of industrial waste declared ordinary per year, the economic cost for companies is 18 million euros per year.

In addition to this economic cost, we should bear in mind the opportunity cost of this waste. This issue poses many questions whose answers we do not currently have: what resources could potentially be recovered from the waste and turned into materials with a market demand? What recycling technologies currently exist? What companies generate waste and what waste could be used? What would the economic impact of developing these new markets be? What would the environmental impact of recovering this waste be (in terms of materials, CO2 saved, energy saved or water saved)? The social impact (job creation, training and consumer awareness, for example)? To answer all these questions, we have to be able to calculate the Circularity Index, a measure of the potential of business improvement and territorial development based on underused resources.

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5.4.3. The challenge of valorisation

There are 150 waste managers with valorisation technologies in the B30 territory, but only a handful of them are truly capable of transforming waste into recycled materials that are high enough quality for the market (as mentioned above, according to EU figures, only 25-30% of industrial waste is recovered in Europe). It is also worth noting that the current coding system used by managers does not reveal which managers truly valorise waste materials nor where the valorised materials ended up.

This situation contrasts with the objectives and guidelines set by the EU, analysed in the previous section. As stated, the EU promotes and requires waste to be valorised (that is, waste to be transformed into resources) and is implementing regulations with ambitious objectives in relation to waste sorting and recycling, product durability and waste.

Waste valorisation requires the development of recycling technologies and innovative waste collection systems. It also requires changes in product design to facilitate their recycling and the use of recyclable materials. Likewise, the collaboration between actors in the materials value chain is essential to make closing the circularity of materials' life cycles feasible. Therefore, resource valorisation poses many challenges and business opportunities based on research and innovation.

The lack of information, broken-down figures and quality data is a hindrance to retooling the B30 territory towards the circular economy. This problem was detected years ago, but no satisfactory solution has been found yet. The steps in this direction include two prominent initiatives which have been operating for years now:

- The By-product and Raw Materials Exchange is a free service of the General Council of Chambers of Commerce of Catalonia and the Catalonia Waste Agency in which user companies can post announcements of bids and requests for waste, surpluses, by-products and other raw materials which can lower expenses by facilitating the quest for

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opportunities to reuse and recycle these materials. It also chooses to view waste as a resource, a key issue in the transition towards a circular economy mode.

- The Economic Activity Estate Information System (SIPAE), which offers information on urban planning, services and activities. However, many of these data are not broken down, and no data is available on resources (water, energy, waste).

5.4.4. Awareness among the actors

For years the B30 territory has focused on advancing towards the circular economy model with the goals of improving the territory's economic results, lowering the use of resources, prioritising the use of resources available in the territory, creating new job opportunities and lowering the environmental impact of industrial activity. Many municipalities and associations are promoting strategies and initiatives in this direction towards both industry and consumers. Therefore, we could say that there is keen awareness of the need to change the current production and consumption models among the main actors in the B30. Similarly, the Government of Catalonia, via ACCIO, the Department of Territory and Sustainability, the Catalonia Waste Agency and the Employment Service of Catalonia, as well as the Barcelona Provincial Council, are promoting the transition of the production community towards the circular economy via public support.

In turn, universities and research and technology centres also have avenues of research and innovation in the field of the circular economy, which enables them to secure competitive funds in Europe. The public administrations and schools in the territory also promote a variety of measures to encourage responsible consumption and prevent resource waste.

Despite this, the headway towards the circular economy is quite slow. There is a major gap between the social actors' awareness and will and their commitment and action to change. That is, this awareness of the problem is not translating into changes in production or behaviour. Likewise, there is little awareness among actors that without changing individual behaviours it will be hard to make headway towards transforming the territory. The actors tend

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not to identify themselves as part of either the problems or the solutions in the system, and this prevents the collective actions needed to work towards the goal of zero waste from being articulated.

5.5. Main obstacles to advancing towards zero waste

There is a broad array of obstacles to advancing towards the objective of zero waste (in the B30 and many other territories around Europe). One of the main obstacles is the current legislative and regulatory framework, which the EU is changing. However today, there are still important legal limitations on waste management, treatment and use which are an obstacle to reuse and the development of by-product markets.

In addition to the legal obstacles, which the regional actors have little power to change, there are other obstacles which are hindering headway towards the goal of zero waste which the regional actors can influence in many ways, as shown in Table 4.

This table highlights the main associated opportunities and the main obstacles to taking advantage of them from the standpoint of the current situation and the shared vision.

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TABLE 4. OPPORTUNITIES STEMMING FROM REGULATORY CHANGES, OBSTACLES AND THE CURRENT SITUATION

OPPORTUNITIES	OBSTACLES	CURRENT SITUATION
Opportunity to develop a strong recycling industry capable of transforming waste into secondary raw materials in an increasingly demanding market. Waste managers can become recyclers and suppliers of high-quality secondary materials who offer their clients professional services. Opportunity for companies to redesign their products to make them more durable, repairable, recyclable and toxin-free in response to the shifting trend in consumers' demands.	The waste management sector is extremely conservative, not very innovative and unable to shift its business model towards more added-value activities in increasing demand. The development of the market for recycled and second-hand products is very slow. The majority of companies are very small SMEs which do not have the technical, human and financial resources to redesign their products and meet the new consumer demands and the increasingly stringent requirements of EU regulations.	Globally, we are throwing away 60% of all the materials we are using in products and services. Recycled materials only meet 12% of the demand for materials in the EU. The majority of products coming to market do not yet include "circular" criteria or any shelf-life cost for producers. Incentives for manufacturers to introduce improvements in the process are minimal. Business associations are playing a very inactive role in this sphere.
Companies that focus on getting ahead of reporting on the repairability and durability of their products and providing affordable repair services may reach more consumers and boost their turnover.	Consumers have little information on the durability and repairability of products. Small companies do not have the technical, human and economic resources needed to redesign their products and boost their durability and repairability.	80% of European citizens buy ecological products at least occasionally. 64% of consumers repair products, 36% have never repaired products in the past, 90% have no experience renting or buying second-hand products.

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OPPORTUNITIES	OBSTACLES	CURRENT SITUATION
Working with manufacturers of plastic products on designing, collecting and treating their end-of-life products is a huge opportunity for plastic waste recyclers. They can go from being waste managers to suppliers of materials and can become an essential point in the resource-efficient economy. Better product design facilitates the recycling of plastics, creating major opportunities for designers.	Market shares of bioplastics are increasing, but labelling and consumer information are not very clear. No collection and treatment systems appropriate for the waste have been developed. The presence of worrisome chemical substances (such as flame retardants) in plastics limits their recycling. The usually low price paid for plastic materials (either new or recycled) makes it difficult to earn back the investment made during the recycling process.	In the past 50 years, global plastic production has doubled, and only 25% of plastic waste is collected to be reused.
The animal feed industry has a huge opportunity with food waste. Food donations are an interesting market worth exploring with very high social benefits. Preventing food waste yields major savings for families, companies and institutions (like schools or hospitals).	High implementation cost of strategies to lower food waste and difficulty getting all the actors in the value chain involved and articulating their cooperation.	The food sector is responsible for 70% of water consumption. Industrial food activities account for 60% of the loss of global land biodiversity and 25% of greenhouse gas emissions. One-third of the food produced is not used (58% in households, 16% in restaurants and 26% in retail establishments). If we prevented food waste, we could save 841 million euros, feed 0.5 million people and prevent 262.5 tonnes of waste.

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OPPORTUNITIES	OBSTACLES	CURRENT SITUATION
For materials manufacturers: developing recyclable, reusable materials that are easy to disassemble with renewable raw materials. For builders and designers: zero-waste construction, energy-efficient buildings with renewable energy sources. For the public administration: encouraging public procurement in licenses and tenders.	The construction sector is highly complex (it includes a number of different stakeholders) and conservative.	The construction sector is responsible for the global extraction of 50% of the materials, 50% of the energy consumption and one-third of water consumption. Construction and demolition waste account for 25-30% of all waste in the EU.
The repair business will generate new jobs and new business models in the forthcoming years.	The main barrier to developing repair business models is the high cost of repairs and spare parts, as well as the vast diversity of products and parts.	37% of products cannot be repaired.
Reuse centres and networks and the technologies that make them possible can stimulate the reuse of products.	The legal framework for second-hand products (requirements on the information that has to be supplied with products that are not in their original packaging) or liability for damages.	One-third of goods that reach recycling centres are reusable and could be sold second-hand.
High economic potential for disruptive collaborative business models around high added-value products. The typical products are mobility and flats, but there are major opportunities for other products, like farm machinery and washing machines.	Increasing concern about the side effects, which are leading to liability issues.	Collaborative practices are being developed in the informal sector which are not always captured by the economic statistics but which may be contributing significantly to the circular economy.

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